Consumer and Corporate Affairs Canada
Consommation et Corporations Canada

(11) (A) No. 1 189 434

(45) ISSUED 850625

(52) CLASS 154-69

(51) INT. CL. 4 B32B 13/12,31/12

# (19) (CA) CANADIAN PATENT (12)

(54) Wallboard Made from Gypsum and Plastic Facing Material

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(21) APPLICATION No. 396,368

(22) FILED 820216

No. OF CLAIMS 11 - NO DRAWING

Canada

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CCA-274 (11-82)

## ABSTRACT

This invention relates to a new improved gypsum wallboard product and to a novel method of making the improved gypsum wallboard product. The gypsum wallboard product comprises a gypsum core substantially enclosed within a water vapour permeable synthetic polymeric sheeting. The invention also relates to a process for the preparation of a gypsum wallboard product comprising spreading a fluid gypsum hemihydrate slurry between two substantially parallel vapour permeable polymeric sheets and allowing the gypsum hemihydrate to set and bond to the sheets.

## FIELD OF THE INVENTION

This invention relates to a new improved gypsum wallboard product and to a novel method of making the improved gypsum wallboard product. More particularly, this invention is directed to a gypsum wallboard product that is produced using water vapour permeable synthetic polymeric facing materials enclosing a gypsum core.

## BACKGROUND OF THE INVENTION

Gypsum wallboard is traditionally manufactured by a continuous process wherein a slurry of calcium sulphate hemihydrate, water, water reducing agents, bonding agents, set control agents and anti-burning agents is deposited on a lower, continuously advancing web of paper, and an upper, continuously advancing web of paper is laid over the slurry. The paper and gypsum slurry are passed between parallel horizontal upper and lower forming rolls and integrated into a continuous flat envelope of paper enclosing the unset gypsum. The continuous product thus formed is conveyed on a continuous moving belt until the slurry has set. The strip or sheet is then cut to form boards of prescribed length, after which they are passed through an oven or kiln to be dried until the excess water in the gypsum board has evaporated.

In the production of gypsum wallboard it is customary to use multi-ply paper facing materials which are generally manufactured from waste paper grades or other pulp sources, employing conventional papermaking techniques. Wallboard paper liners produced by

conventional papermaking processes possess a number of inherent properties or characteristics which detrimentally affect the final gypsum wallboard product. One such property is the difference in tensile strength between the machine direction of the paper (the direction of the paper as it travels through the paper making machinery) and the cross (lateral) direction (right angle to the machine direction). Typically the machine direction tensile strength is three to four times stronger than the cross (lateral) directional strength. This imbalance of paper strength properties results in a finished gypsum board product with dissimilar directional strength characteristics. Since a minimum specification degree of strength must be achieved by the gypsum board, regardless of paper direction, the board and paper strength requirements are necessarily determined by their weakest direction. As a result of this anisotropy of the paper, and in compensation of the imbalance, a relatively thick paper liner (thicker than necessary in the in machine-line direction) must be used if minimum strength requirements are to be met.

A further disadvantage of wallboard paper liners is their susceptibility to abrasion surface damage on the face of the wallboard due to the relatively soft fibrous nature of the cellulosic ingredients of the paper and to the relatively weak chemical forces which hold the fibres together. A coating of some type is always required to increase the resistance of this product to damage after application. In spite of this

protective coating, the gypsum wallboard face still has relatively poor resistance to abrasion and impact force. This deficiency is most detrimental to the product for applications in high occupancy buildings such as banks, offices, and the like. To overcome this problem, gypsum wallboard is commonly covered with a decorative polyvinylchloride plastic film applied to the gypsum wallboard surface.

Production of an abrasion and impact resistant wallboard by substituting a plastic film for the wallboard paper liner in the primary manufacturing process is generally not possible since the plastic film is impermeable to water vapour thereby making it impossible to dry the wallboard. Normally, an abrasion resistant, impact resistant, vinyl covered wallboard (known generically as vinyl board) is produced by a secondary manufacturing operation in which the decorative vinyl film is adhesively laminated to the face surface of the gypsum wallboard. This ancillary operation substantially increases the cost of the finished wallboard product.

The degree with which paper products undergo changes in physical properties upon adsorption or absorption of water can also affect the manufacture and use of conventional gypsum board. The manufacturing process is affected by the adsorbed water content of the paper being used. This in turn is dependent on several factors such as time since manufacture, storage conditions, and the like. The rate of water absorption into the paper from the gypsum slurry is also a function

of many parameters and is of great importance in the production of a quality gypsum board product. Paper expansion due to the effect of the water absorption by the paper must be taken into account if a gypsum board of correct dimensions is to be obtained. Considerable effort has been made to overcome these problems using sizing agents during paper manufacture.

The effect of water adsorption and subsequent paper expansion also limits the types of applications considered acceptable for some gypsum board products. Under conditons of high humidity, for example, the use of a low caliper (9.5 mm) gypsum board for ceiling applications can result in the gypsum board sagging between the support structures. One major factor contributing to this effect is the expansion of the paper liner such that it no longer supports the core. This problem can be especially serious if the gypsum board product is held at ceiling level using support tracking, etc. rather than by direct attachment using nails or screws.

## SUMMARY OF THE INVENTION

We have discovered that certain types of water vapour permeable plastic (synthetic polymeric) film or sheeting can be used instead of wallboard paper liners to produce a decorative gypsum wallboard with excellent abrasion, impact and sag resistance properties. Surprisingly, the plastic films can be used in the primary gypsum wallboard manufacturing process and the wallboard can be satisfactorily dried without detriment to the bond between the plastic facing material and the

gypsum wallboard core. Furthermore, achieving the production of a gypsum wallboard with a decorative plastic finish without processing through a secondary laminating operation has been entirely unexpected to those skilled in the art of wallboard manufacture.

The plastic films comprise a family of spun-bonded polymers such as poly-olefins which family is produced by first spinning continuous strands of the polymers, such as high-density polyethylene into a very fine, interconnected web of fibres and then bonding the fibres together with heat and pressure. The product after bonding displays a good printing or coating surface, high opacity, and toughness to a degree unique among sheet or film products of similar weight.

The invention is directed to a gypsum wall-board product which comprises a gypsum core, at least one side of which is substantially covered by a water vapour permeable synthetic polymeric web which may be composed of spunbonded polymeric filament or spunbonded polyolefin filament.

In the product according to the invention, the polyolefin may be polyethylene and particularly high-density polyethylene. The spunbonded polyolefin filament sheeting or film may be a product available from DuPont of Canada Limited in association with the trade mark TYVEK.

The invention is also directed to a process for the preparation of a gypsum wallboard product comprising spreading a fluid gypsum hemihydrate slurry between two substantially parallel vapour permeable

sheets, at least one of which is synthetic polymer, and allowing the gypsum hemihydrate to set and bond to the sheets. In the process, the product may be passed through an oven to remove excess water in the gypsum board. The polymeric sheeting or film may be composed of spunbonded polyolefin filament, for example, high density polyethylene filament.

## DETAILED DESCRIPTION OF THE INVENTION

Gypsum wallboard samples were prepared in the laboratory using spunbonded olefin liners. The board products were evaluated in a number of standard testng procedures using a regular, paper lined gypsum board as a control sample.

The following examples demonstrate the properties of this new product and the process by which it is made.

### Example 1

A laboratory board sample 1/2 inch (12.7 mm) thick was prepared using the spun bonded polyethylene sheeting in the following manner. A piece of Tyvek* 1085 sheeting (spunbonded high density polyethylene) was cut with dimensions 14-1/2" (368.3 mm) by 28" (711.2 mm). The specific product used was uncoated Tyvek*, but other sheeting manufactured in the same manner with the same range of properties would be suitable. This material was folded and creased at positions 3/4" (19.05 mm) and 1-1/4" (31.75 mm) from each of the 28" edges to form an envelope similar to that used in the conventional gypsum board process. This envelope was then clamped in a laboratory board forming apparatus. A

piece of liner of dimensions 11-3/4" (298.5 mm) by 28" (711.2 mm) was also clamped in the laboratory board forming apparatus such that it would form the back face of the laboratory board. Double sided adhesive tape was applied to the bottom sheeting along a 3/4" (19.05 mm) wide strip to come into contact with the upper liner sheet upon sample preparation.

The slurry to be used in preparation of the board sample was prepared as follows: a surfactant foam solution (173 ml at 0.7% by weight Cedepal* FA406 foaming agent) was premixed for one minute using two Hamilton Beach Scovill Mixers (Model 936-2SA) at high speed (86.5 ml in each mixer cup). While mixing the foam, a mixture of calcium sulphate hemihydrate (1563 g) and ground gypsum accelerator (1.13 g) was added to the bowl of a Hobart* Model N-50 mixer containing 1042 ml of water, 3.63 g of paper pulp, 1.62 g of Lomar D* superplasticizer and 11.34 g of starch. The mixture was stirred at low speed for 2 seconds and the premixed foam was added to the bowl. The entire mixture was stirred at high speed for 30 seconds. The resultant slurry was poured onto the bottom sheet of the laboratory board apparatus and the top sheet rolled into place using a heavy steel roller.

Upon setting, the apparatus was dismantled and the sample was trimmed to a length of 16" (406.4 mm). This sample was then dried in a circulating air oven at 115°C for 60 minutes, and then at 40°C overnight.

Performance Tests

The laboratory board sample prepared according

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to the procedure in Example 1 above was compared to a sample of commercial 12.7 mm board by performing the following tests:

Comparison of Spun-bonded Polyethylene Covered Gypsum Board to Commercial Gypsum Board

| Property | Commercial Gypsum Board | Tyvek* 1085 Board | Test Method Reference |
|---|---|---|---|
| Thickness (mm) | 12.7 | 12.7 | 1 |
| Weight(kg/100m$^2$) | 899 | 934 | 1 |
| Breaking Strength (N) | | | |
| Cross | 225 | 250 | 1 |
| Machine | 776 | 250 | 1 |
| Nailhead Pull Resistance (N) | 487 | 507 | 1 |
| Humidified Deflection (mm) | 25 | 5 | 1 |
| Impact Resistance (joules/mm) | 0.356 | 0.783 | 2 |
| Bond (N/76 mm) | | | |
| Peak | 35 | 24.5 | 3 |
| Plateau | 13 | 22.0 | 3 |
| Durability (mm/100 revolutions) | 0.254 | 0.001 | 4 |

## Test Methods

Reference 1

Canadian Standards Association A82.20.3-M 1977.

Reference 2

Canadian Government Specifications Board 41-GP-24.

Reference 3

Measurements of bond of the liner to the core were performed by cutting a 3 inch (76.2 mm) wide

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portion of board 12 inches (304.8 mm) long, scoring one side, breaking the core and using an Instron testing apparatus to measure the force required to pull the liner away from the core at 90°C. The peak value corresponds to the maximum force required, whereas the plateau value corresponds to the flat section of the bond strength curve immediately after the peak.

Reference 4

Durability was measured using a Tabor* Abraser equipped with CS-10 abrasion wheels. The measurements were performed using the 250 g arms as load to the abrasion wheels. After 1000 revolutions, the samples were measured using a micrometer at four locations inside the abrasion ring and four locations immediately adjacent to the abrasion ring. The difference between the average of these two sets of data was reported.

## Example 2

To demonstrate the improved characteristics of a gypsum board product of reduced thickness, samples were prepared using Tyvek* 1073 sheeting in which the overall thickness was 6.35 mm. The procedure used was the same as outlined in Example 1 except the spacers in the moulding table were 6.35 mm thick, the bottom liner was 35.6 cm wide and creased 19.1 mm and 25.4 mm from each 71.1 cm edge, and the foam solution was added directly to the water rather than premixing using the Hamilton Beach mixer.

The board samples produced were then tested and compared to commercial 12.7 mm board as shown by the following Table. As can be seen from these results, the

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spunbonded olefin sheeting product offered several advantages over the conventional 12.7 mm board. The data indicates that the product would be suitable for ceiling tile applications.

Comparison of Spun-bonded Polyethylene Covered Gypsum Board to Commercial Gypsum Board

| Property | Commercial Gypsum Board | | Tyvek* 1073 Board | | Test Method Reference |
|---|---|---|---|---|---|
| (Sample No.) | (A) | (B) | (1) | (2) | |
| Thickness (mm) | 12.7 | 12.7 | 6.35 | 6.35 | 1 |
| Weight(kg/100m$^2$) | 899 | 879 | 626 | 804 | 1 |
| Breaking Strength (N) | | | | | |
| Cross | 225 | | | | |
| Machine | 776 | | 103 | | 1 |
| Nailhead Pull Resistance (N) | 487 | | 231 | | 1 |
| Humidified Deflection (mm) | | 18 | | 5 | 1 |
| Surface Water Resistance (g) | 2.1 | | 1.1 | | 1 |
| Impact Resistance (joules/mm) | 0.356 | | 0.712 | | 2 |

Test Methods 1 and 2 as described in Example 1.

As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the spirit or scope thereof. Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.

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The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A gypsum wallboard product which comprises a gypsum core substantially covered by a water vapour permeable synthetic polymeric web.

2. A product as defined in Claim 1 wherein the polymeric web is spunbonded polymeric filament.

3. A product as defined in Claim 1 wherein the polymeric web is spunbonded polyolefin filament.

4. A product as defined in Claim 3 wherein the polyolefin is high-density polyethylene.

5. A product as defined in Claim 4 wherein the product is intended for use as ceiling tile.

6. A product as defined in Claim 3, 4 or 5 wherein the spunbonded polyolefin filament web is a spun bonded polyolefin sheeting or film.

7. A product as defined in Claim 1, 2 or 3 wherein only one face of the product is composed of synthetic polymeric sheeting or film.

8. A process for the preparation of a gypsum wallboard product comprising spreading a fluid gypsum hemihydrate slurry between two substantially parallel vapour permeable sheets or film at least one of which is a synthetic polymer, and allowing the gypsum hemihydrate to set and bond to the sheets.

9. A process as defined in Claim 8 wherein the product is passed through an oven to remove excess water in the gypsum board.

10. A process as defined in Claim 8 or 9 wherein the polymeric sheeting or film is of spunbonded polyolefin filament.

11. A process as defined in Claim 8 or 9 wherein the polymeric sheeting or film is of spunbonded high-density polyethylene.

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*il n'y a PAS DE DESSINS*